

MALFUNCTION OF ECDYSIS AND FEMALE BIASED
MORTALITY IN URBAN *BRASSOLIS SOPHORAE*
(NYMPHALIDAE: BRASSOLINAE)

ALEXANDRE RUSZCZYK

Departamento de Biociências, Universidade Federal de Uberlândia,
Uberlândia MG, 38.405-382, Brasil

AND

MARTINHO C. CARVALHO JR.

Departamento de Zoologia—IB, UNICAMP, C.P. 6109,
Campinas SP, 13.081-970, Brasil

ABSTRACT. Adult mortality of *Brassolis sophorae* (L.) (Nymphalidae: Brassolinae) was studied on the State University campus in Campinas, São Paulo, Brazil, emphasizing mortality during ecdysis (pupa to imago). Four buildings were examined during the breeding season of *B. sophorae* in 1987 and 1989. The number of resting or dead adults were recorded and their weight and wing length were measured. The imagos from pupae attached to buildings suffered a high mortality and/or malfunction of ecdysis (nearly 20% of the individuals). High mortality was related either to direct human intervention, such as damage and removal of pupae and adults or to the use of smooth surfaces on the buildings by larvae for pupation. Smooth surfaces can cause difficulties in tarsal adherence of recently emerged adults. Females were significantly more subject to injury than males because (1) they usually rest on lower sites more susceptible to disturbance, and (2) they are heavier than males causing more difficulties in adhering to smooth surfaces during wing expansion.

Additional key words: urban ecology, urban insects, sexual dimorphism, butterfly mortality.

Adult *Brassolis sophorae* (L.) (Nymphalidae: Brassolinae) use human structures as resting sites and thus frequently are disturbed by man. On the campus of Universidade Estadual de Campinas (Campinas State University—UNICAMP) we observed many teneral adults of *B. sophorae* bearing nonfunctional or damaged wings. Malfunction of ecdysis is rare in natural populations of butterflies (Neck 1979). This contrasting situation led us to quantify the fates of emerging adults as well as the exploitation by this insect of building structures as resting sites. The adult stage usually has not been included in previous studies on the mortality of Lepidoptera in urban areas (Itô & Miyashita 1968, Sternburg et al. 1981, Ruszczyk 1986, Bastian & Hart 1990).

Brassolis sophorae is a crepuscular butterfly with a vestigial, non-functional proboscis. The gregarious larvae feed on palms (Arecaceae), both native (*Syagrus* spp., *Euterpe* spp., *Copernicia* spp.) and exotic (*Cocos* spp., *Washingtonia* spp., *Roystonea* spp., *Phoenix* spp.), and may become pests (Cleare 1915, Copeland 1921, Costa Lima 1936), even in highly developed sections of Brazilian cities (Ruszczyk unpubl. data). The larvae usually pupate in garages, retracted skirting-boards,

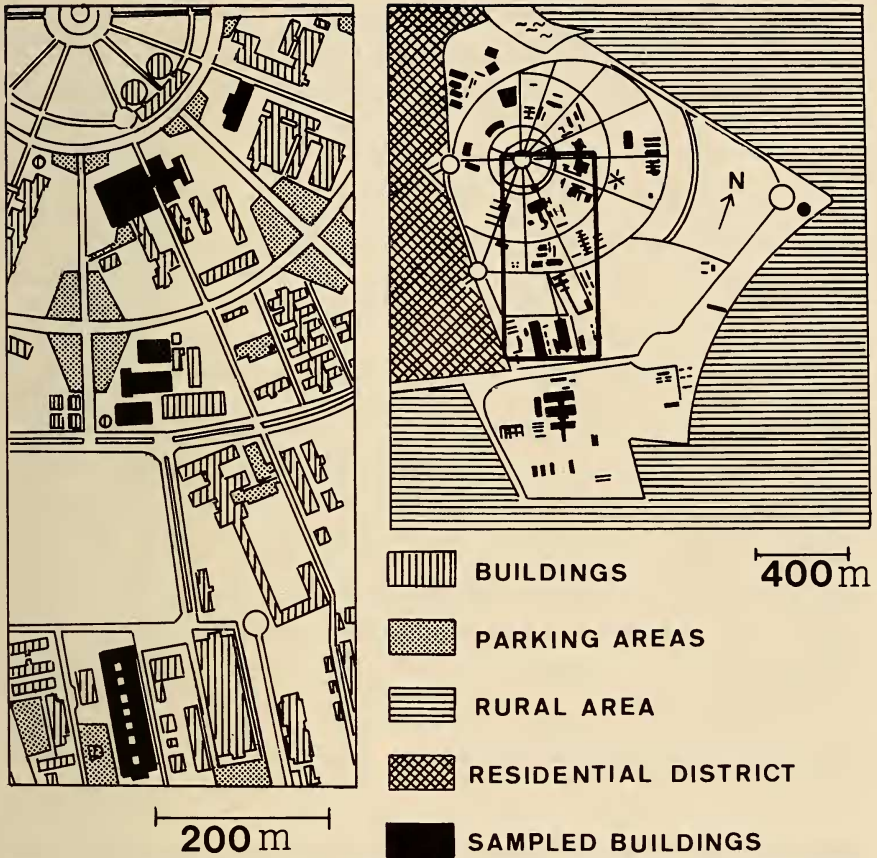


FIG. 1. UNICAMP campus (right map). Shaded buildings (left map) were daily censused for resting *Brassolis sophorae* during November–December 1987 and 1989. Shaded buildings from top to bottom, Physics Institute, Chemistry Institute, Food Technology Institute and Administration, respectively.

and mail boxes where a high pupal survival occurs because of partial protection against parasitoids (Ruszczyk unpubl. data). The life history of *B. sophorae* was described by Cleare and Squire (1934).

MATERIALS AND METHODS

Study Area

Four buildings on the UNICAMP university campus with palm trees [predominantly *Syagrus romanzoffiana* (Cham.) Glassman] planted near the walls were censused for resting and dead butterflies (Fig. 1, left). The campus (Fig. 1, right) is twenty-five years old and was landscaped intensively with both native and exotic trees. Large open lawns occupy

TABLE 1. Adult fate, resting site, and height of adult *Brassolis sophorae* recorded in four buildings at the Campinas State University. The frequencies of males (Ma) and females (Fe) in different situations were compared using Chi-square.

	1987		1989		Total	
	Ma	Fe	Ma	Fe	1987	1989
Adult fate						
Nonfunctional wings	23	40	2	24	63	26
Squashed (man)	3	23	—	12	26	12
Spider predation	5	4	1	1	9	2
Bird predation	—	2	—	12	2	12
Unknown mortality	3	7	1	3	10	4
Total	34	76***	4	52	110	56
Resting site						
Ceiling	69***	14	31**	21	83	52
Wall	32	50**	19	20	82	39
Column	27	13	9	19	40	28
Window sill	7	15**	2	6	22	8
Girder	6	6	10	5	12	15
Instrument box	9	6	2	4	15	6
Pipe	6	6	2	2	12	4
Window grating	3	1	—	3	4	3
Others	10	28	3	18	38	21
Total	169	139	78	98	308	176
Height						
Above 2 m	121***	61	59**	63	182	122
Between 0.3–2 m	45	63*	18	26	108**	44
Below 0.3 m	5	41***	9	30**	46	39
Total	171	165	86	119	336	205

*, **, *** = $P < 0.05$, 0.01 and 0.001, respectively.

most of the area. The buildings are surrounded by groups of common garden plants such as *Strelitzia reginae* Banks (Musaceae), *Acalypha wilkesiana* Muell. Arg (Euphorbiaceae), and *Rhododendron simsii* Planch (Ericaceae).

Data Collection

The buildings were surveyed daily for 2–3 h during breeding season (November–December) in 1987 and 1989. All adults found resting on the external walls and other structures were recorded. Notes were made on their sex, resting height, type of the resting site, presence of damaged wings (vestiges of beak marks) on the pavement, squashed individuals, and individuals with unexpanded or crumpled wings. In 1989, all individuals were collected and weighed, and the forewing length was measured. Chi-square tests were used to compare the frequencies of males and females in different heights, resting sites, and fates.

RESULTS AND DISCUSSION

A total of 127 adults died by squashing or malfunction of ecdysis (Table 1). These mortality factors affected females more than males, to varying degrees on different buildings. Females were preyed upon preferentially by a flock of guira cuckoo (*Guira guira* Gmelin, Cuculidae) that foraged daily in the palm trees of internal and external gardens. Predation was confirmed by direct observations of aerial attacks and collection of beak-marked wings. This visually oriented predator may select females due to their slower flight and larger body. Webs of *Nephilengys cruentata* Simon (Araneidae), an orb-weaver spider common in urban areas, were observed to have caught 11 individuals. It is common to find one or two *B. sophorae* in the same web. *Nephila clavipes* L. (Levi), another orb-weaver found infrequently on buildings, regularly catches butterflies in non-urban sites, but the predation is not species-specific (Vasconcellos-Neto & Lewinsohn 1984).

Brassolis sophorae is dimorphic; females are approximately twice as heavy as males (Fig. 2). Because the adult butterfly does not eat or drink, its maximum weight occurs at the time of emergence. The time interval from emergence to the first flight is greater than 24 h, exposing the insects to disturbance. The newly emerged imago is able to walk to the adjacent substrate to complete wing expansion. This behavior is highly adaptative in non-urban sites where the larvae usually pupate under debris, tree bark, or crevices and fissures in tree trunks.

In urban settings, however, many imagos are unable to hang onto smooth surfaces and fall. Such falls to the pavement often cause internal traumas and result in loss of internal fluids as evidenced by a film left on the pavement. Damaged butterflies usually crawled towards walls or man-made structures, continuing the process of wing expansion. Many individuals were squashed during this process. Being heavier than males, the females were more susceptible to falls from smooth surfaces.

The sexes differed in relation to resting site preference (Table 1). Males were found more frequently hanging onto the ceiling of protected walkways where they were partially protected from human interference, whereas females were found principally on walls and window sills. Males escaped more readily from humans and were less conspicuous owing to their smaller size.

In the two sampling periods, more than fifty percent of imagos observed were resting greater than 2 m above the surface, with a significant predominance of males at this height (Table 1). On the other hand, females were observed predominately below 2 m. This vertical stratification probably increased the risk of females being disturbed or

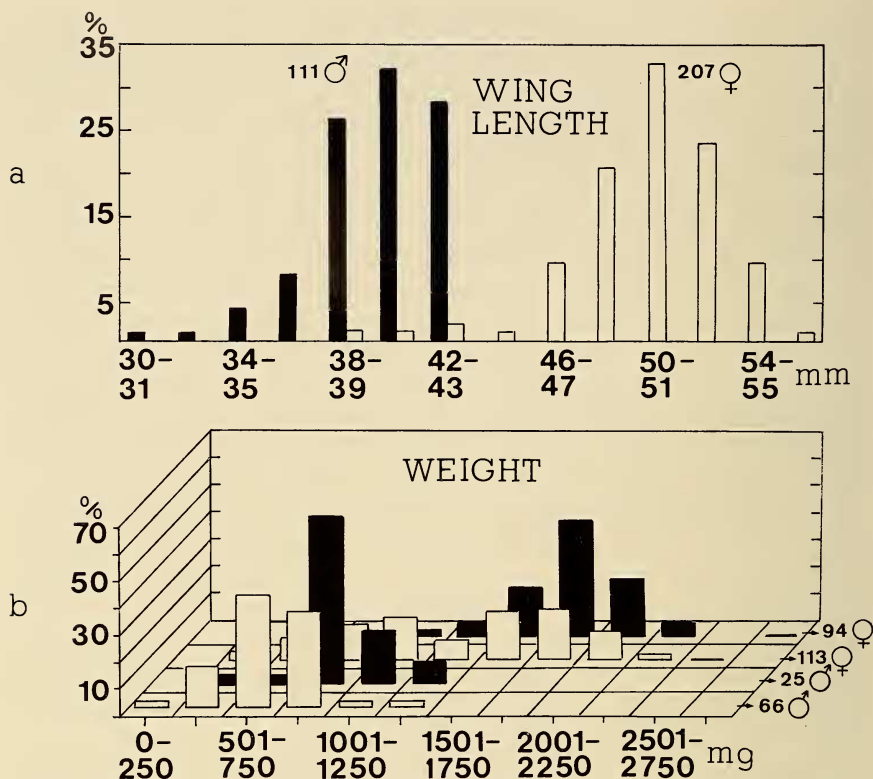


FIG. 2. Class distribution of adult male (shaded bars) and female (clear bars) wing-lengths (a). Class distribution of weight of newly emerged (shaded bars) and resting (clear bars) male and female of *Brassolis sophorae* collected at the UNICAMP campus.

squashed. The high frequency of human induced mortality factors and the female biased mortality suggest an adverse effect on the population. This high rate of mortality is in contrast to the rare malfunction of ecdysis observed in the wild. For example, Harcourt (1966) found a negligible number of dead adults of *Pieris rapae* L. (Pieridae) due to imperfect ecdysis.

It has been demonstrated that adult *B. sophorae* are selective in resting sites, in particular height. There were no significant differences in the data obtained in the two years sampled (last two columns of Table 1). The only exception was the number of individuals found resting at the height between 0.3 and 2.0 m. This suggests an incipient pattern of human architectural exploitation. Rather than the result of evolutionary change in response to specific urban selective pressures, this pattern may represent adaptation to the natural environment, such as the habit of resting in shaded places under similar materials used in

buildings. The details of human architecture may be physically similar to the shaded natural shelters.

In the butterfly's own world (in the sense of Uexkull 1909), a building may be perceived as a multifaced rock or tree trunk. The capacity of exploiting human structures as resting sites is an adaptive character of *B. sophorae* to the urban habitat where shaded and low temperature sites are not abundant, especially in the central areas of cities.

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